

**CLAIMS:**

1. A photodetector circuit including a photodiode detector and associated readout circuitry, the circuit comprising a semiconductor handle substrate of one conductivity type supporting the readout circuitry, and an insulating layer on the handle substrate electrically insulating the readout circuitry from the substrate, and the photodiode detector comprising an avalanche photodiode having a first active region of the opposite conductivity type to the handle substrate incorporated in the handle substrate and a second active region of said one conductivity type incorporated in the handle substrate so as to define an active electrooptical junction within the handle substrate between the first and second active regions.
2. A photodetector circuit according to claim 1, wherein the insulating layer on the handle substrate comprises SiO<sub>2</sub>.
- 15 3. A photodetector circuit according to claim 1 or 2, wherein the readout circuitry comprises at least one MOS component.
4. A photodetector circuit according to any preceding claim, wherein there is at least one epitaxial layer on the first active region to provide a resistance in series with the photodiode detector to control the voltage characteristic of the photodiode detector.
- 20 5. A photodetector circuit according to claim 4, wherein there are two epitaxial layers comprising a lower epitaxial layer on the first active region which is substantially undoped so as to provide a high resistance and an upper epitaxial layer on the lower epitaxial layer which is of the same conductivity type as the first active region.
- 25 6. A photodetector circuit according to claim 4 or 5, wherein the or each epitaxial layer is provided within a window in the insulating layer.
- 30 7. A photodetector circuit according to claim 4, 5 or 6, wherein a metal contact is connected to said at least one epitaxial layer.

8. A photodetector circuit according to claim 7, wherein the metal contact is connected to a selectively doped part of said at least one epitaxial layer.

5 9. A photodetector circuit according to any preceding claim, which is adapted to be back illuminated, wherein the substrate has a thinned portion to enable light incident on the back of the substrate to reach the active electrooptical junction.

10. 10. A photodetector circuit according to claim 9, wherein a buried light-shielding layer is provided to prevent light incident on the back of the substrate from reaching the readout circuitry.

11. A photodetector circuit according to claim 9 or 10, wherein a metal contact is connected to a doped layer on the back of the substrate.

15 12. A photodetector circuit including a photodiode detector and associated readout circuitry, the circuit comprising a semiconductor handle substrate of one conductivity type supporting and electrically insulated from the readout circuitry, and the photodiode detector comprising a first active region of the opposite conductivity type to the handle substrate incorporated in the handle substrate, a second active region of said one conductivity type incorporated in the handle substrate so that the first and second active regions form a diode, and at least one epitaxial layer on the substrate providing a resistance in series with the diode to control the current-voltage characteristic of the diode.

25 13. A photodetector circuit according to claim 12, wherein the first and second active regions are formed by implantation of dopant materials of different conductivity types.

30 14. A photodetector circuit according to claim 12 or 13, wherein there are two epitaxial layers comprising a lower epitaxial layer on the first active region and which is substantially undoped so as to provide a high resistance, and an upper epitaxial layer on

the lower epitaxial layer which is of the same conductivity type as the first active region.

15. A photodetector circuit including a photodiode detector and associated readout circuitry, the circuit comprising a semiconductor substrate supporting and electrically insulated from the readout circuitry, and the photodiode detector having an active electrooptical junction incorporated in a thinned portion of the substrate so as to detect light which is incident on a back surface of the substrate and which is not received by the readout circuitry.

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16. A photodetector circuit according to claim 15, wherein a buried light-shielding layer is provided to prevent light which is incident on the back surface of the substrate from reaching the readout circuitry.

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17. A photodetector circuit according to claim 15 or 16, wherein a metal contact is connected to a doped layer on the back of the substrate.

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18. A method of making a photodetector circuit incorporating a photodiode detector and associated readout circuitry, the method including the steps of providing an electrically insulating layer on a semiconductor handle substrate of one conductivity type, forming the readout circuitry on top of the insulating layer, forming a window in the insulating layer, and forming the photodiode detector within the window by implanting a first active region with dopant of the opposite conductivity type to the handle substrate and implanting a second active region with dopant of said one conductivity type so as to define an avalanche photodiode within the handle substrate.

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19. A method according to claim 18, further including the step of growing at least one epitaxial layer on the avalanche photodiode to provide a resistance in series with the photodiode detector to control the current-voltage characteristic of the photodiode detector.

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20. A method of making a photodetector circuit incorporating a photodiode detector and associated readout circuitry, the method including the steps of providing an electrically insulating layer on a semiconductor substrate, forming the readout circuitry on top of the insulating layer, forming the photodiode detector on the substrate, and  
5 thinning the substrate in the vicinity of the photodiode detector so as to enable the photodiode detector to detect light which is incident on a back surface of the substrate and which is not received by the readout circuitry.

21. A method according to claim 20, further including the step of forming a buried  
10 light-shielding layer within the substrate to prevent light incident on the back of the substrate from reaching the readout circuitry.

22. A method according to claim 20 or 21, further including the step of bonding together two semiconductor wafers to form the insulating layer sandwiched between the  
15 semiconductor substrate and a semiconductor layer within which the readout circuitry is formed.

23. A method according to claims 21 and 22, wherein the light-shielding layer is formed in one of the semiconductor wafers before the wafers are bonded together.  
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24. A photodetector circuit substantially as hereinbefore described with reference to the accompanying drawings.

25. A method of making a photodetector circuit, substantially as hereinbefore described with reference to the accompanying drawings.  
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